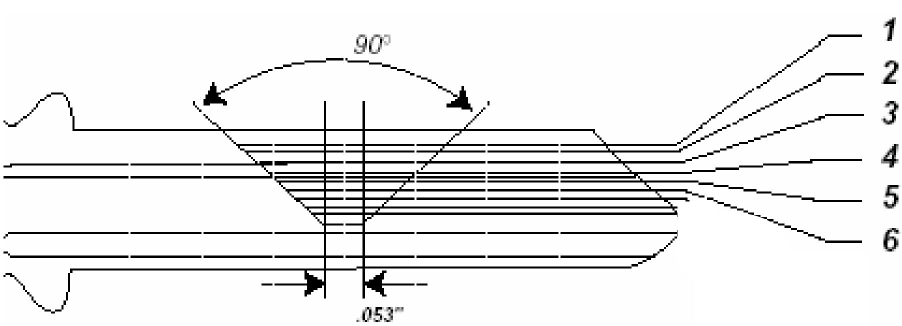
Mathematics of Master Keying

This small handout cannot possibly address the many complexities of master keying and the capacity of one specific master key system relative to another. Rather, this simplification is designed to provide the architectural hardware consultant and sales person enough basic technical and mathematical principles to be comfortable handling a keying conference and submitting expansion specs to the factory for new systems and additions to existing systems.

All numbers referenced here are *theoretical* and are based on one keyway. The are offered for comparison and general understanding only. Actual numbers will be smaller due to physical limitations in certain cylinders and in cutting keys. Cross keying and selective master keys reduce the numbers further. Master ring cylinders, on the other hand, use totally different rules and yield much larger systems.

If you are planning a new system and find that the expansion numbers are a 'close fit' for one or more levels of keying, check with the Corbin Russwin Key Systems Department ***before*** committing to the expansion with you customer.

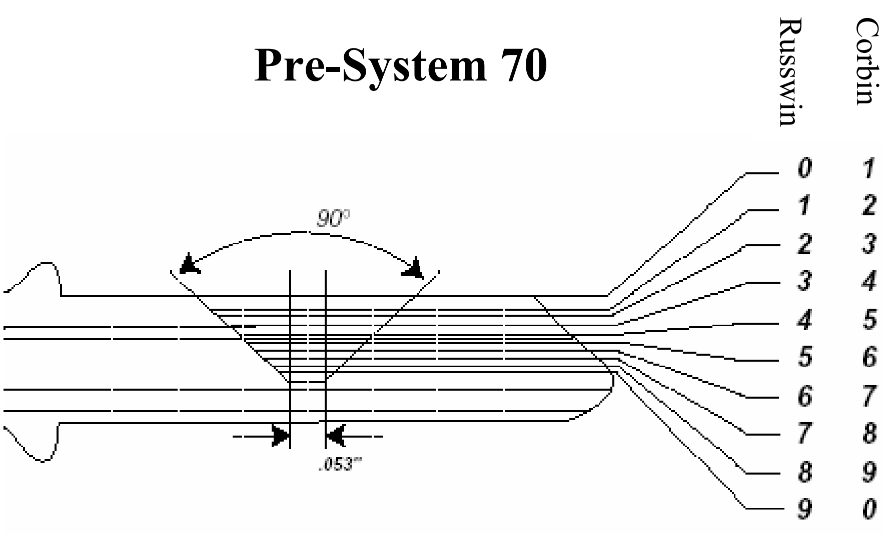
System 70



In System 70, the increment between depths is large enough that you can use every depth in each cut position of keys within the same system.

There are 6 depths total. Removing one for the top master key leaves 5 for progression. Therefore, **the multiplier for System 70 is 5.**

Pre-System 70

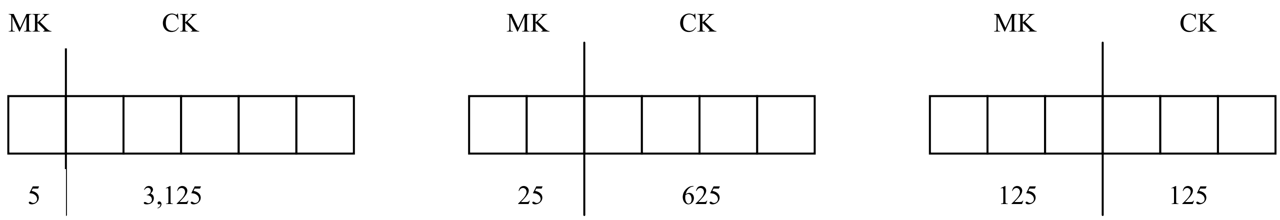


In Pre-System 70, the increment between depths is so small that you must skip every other depth in each cut position of keys within the same system.

Each cut uses either odd or even depths, totaling 5 for any one cut. Removing one for the top master key leaves 4 for progression. Therefore, **the multiplier for Pre-System 70 is 4.**

System 70 Guidelines

Grand Master Key Systems
6-pin



Note: each square represents one pin chamber of the cylinder/key

Example:

1. System spec is 1-20-50 (1GMK, 20 MKs and 50 changes under each MK)
    - Possible with 1 keyway: 2 chambers (5x5=25) for MKs and 3 chambers (5x5x5=125) for changes.
    - Done with one chamber to spare.
    - Remember, the top master (here, the GMK) is always “free.” You don’t do any progression to obtain it.

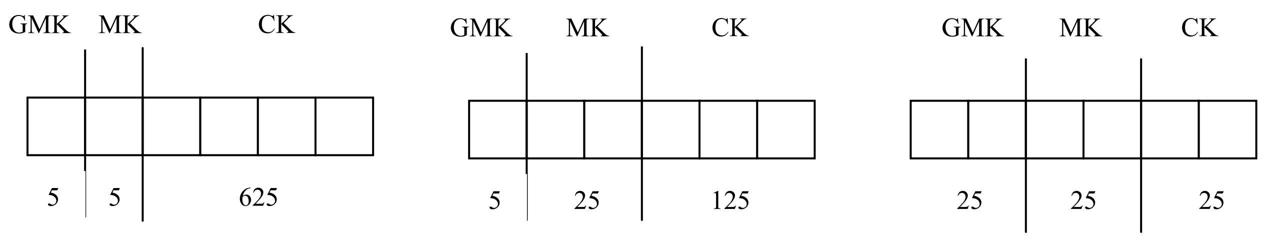
2. System spec is 1-50-150 (1 GMK, 50 MKs and 150 changes under each MK)
    - Not possible with 6-pin cylinder on 1 keyway: MKs need 3 chambers (5x5x5=125) and changes need 4 chambers (5x5x5x5=625)

    Option1: Use 1 keyway with 7 pin cylinders.

    Option2: Use 3 multiplex keyways with 6-pin cylinders. 4 chambers for change keys (5x5x5x5=625) 2 chambers for MKs (5x5=25) and repeat on 2nd and part of 3rd keyways. Theoretically, 2 keyways would suffice (25+25=50) but the 25 is a theoretical number which will be slightly reduced in reality.

System 70 Guidelines

Great Grand Master Key Systems
6-pin



Note: each square represents one pin chamber of the cylinder/key

Example:

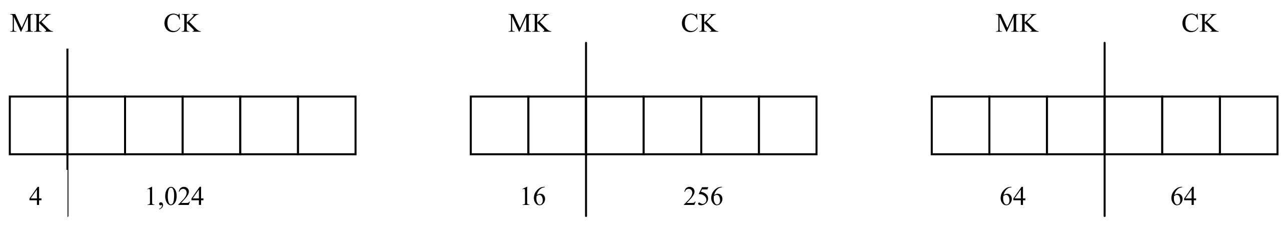
3. System spec is 1-6-10-60 (1GGMK, 6 GMKs, 10MKs under each GMK and 60 changes under each MK)
    - Remember, the top master (here, the GGMK) is always "free". You don't do any progression to obtain it.
    - Not possible on one 6-pin keyway. Need 2 chambers (5x5=25) for GMKs, 2 for MKs and 3 (5x5x5=125) for changes.

Option1: Use 1 keyway with 7 pin cylinders.

Option2: Use 2 multiplex keyways with 6-pin cylinders. 3 chambers for change keys (5x5x5=125) 2 chambers for MKs (5x5=25) and divide the grands to have 3 on the first keyway and 3 on the second.

Pre-System 70 Guidelines

Grand Master Key Systems
6-pin



Note: each square represents one pin chamber of the cylinder/key

Example:

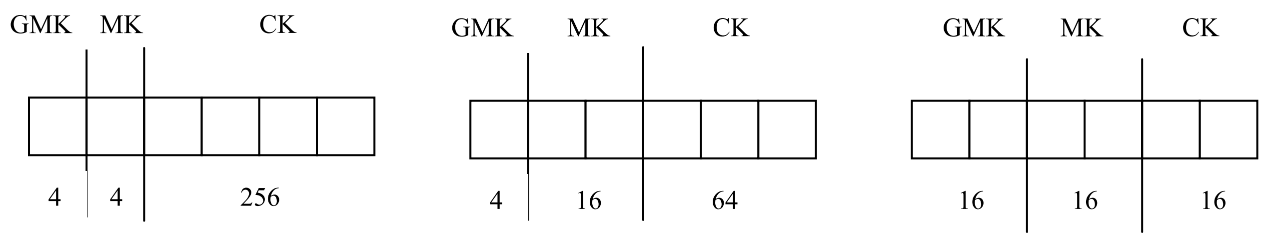
4. System spec is 1-20-50 (1GMK, 20 MKs and 50 changes under each MK)
    - Possible with 1 keyway: 3 chambers (4x4x4=64) for MKs and 3 chambers (4x4x4=64) for changes.
    - Remember, the top master (here, the GMK) is always "free." You don't do any progression to obtain it.

5. System spec is 1-50-150 (1 GMK, 50 MKs and 150 changes under each MK)
    - Not possible with 6-pin cylinder on 1 keyway: MKs need 3 chambers (4x4x4=64) and changes need 4 chambers (4x4x4x4=256)

    Option1: Use 1 keyway with 7 pin cylinders.
    Option2: Use 4 multiplex keyways with 6-pin cylinders. 4 chambers for change keys (4x4x4x4=256) 2 chambers for MKs (4x4=16) repeated on 4 keyways (4x16=64)

Pre-System 70 Guidelines

Great Grand Master Key Systems
6-pin



Note: each square represents one pin chamber of the cylinder/key

Example:

6. System spec is 1-6-10-60 (1GGMK, 6 GMKs, 10MKs under each GMK and 60 changes under each MK)
    - Remember, the top master (here, the GGMK) is always "free". You don't do any progression to obtain it.
    - Not possible on one 6-pin keyway, even with 7-pin cylinders. Need 2 chambers (4x4=16) for GMKs, 2 for MKs and 4 chambers (4x4x4x4=256) for changes. Theoretically, only 3 are needed for changes (4x4x4=64) but 64 is *theoretical* and we need 60 *actual*. Play it safe.

Option1: Use 2 keyways with 7 pin cylinders. 4 chambers (4x4x4x4=256) for changes, 2 chambers (4x4=16) for MKs and 1 chamber (4) for the grands, distributing 3 grands on each keyway.

Option2: Use 6 keyways with 6-pin cylinders. 4 chambers (4x4x4x4=256) for changes and 2 (4x4=16) for MKs. Each of the 6 grands on its own keyway.